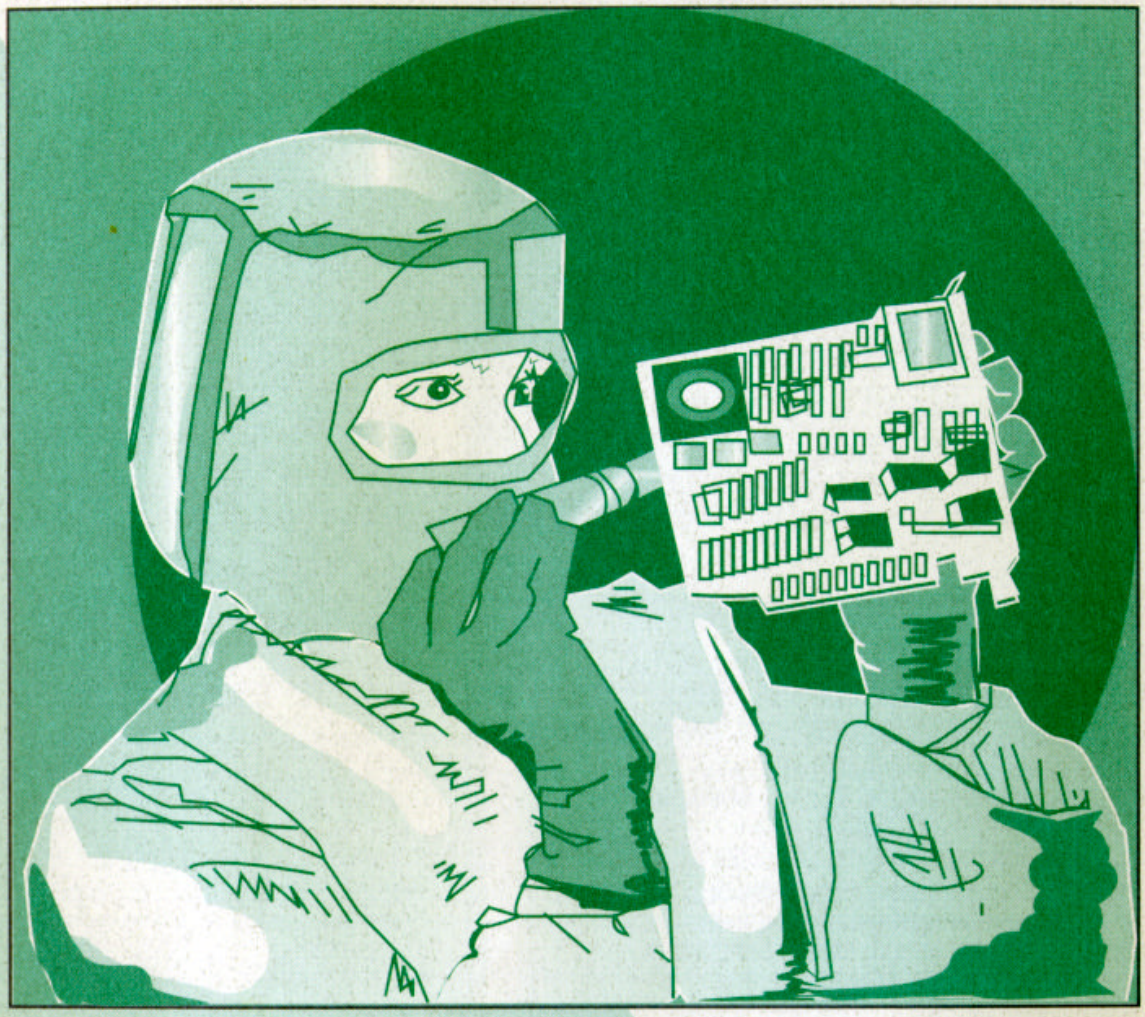


A Guide
on
Hazardous Waste Management
for Florida's

Printed Wiring Board Manufacturers

Hazardous Waste (RCRA)
Compliance Assistance Program

With support from

Virginia Wetherell, Secretary
John Ruddell, Waste Division Director
Bill Hinkley, Solid & Hazardous Waste Bureau Chief
U.S. Environmental Protection Agency, Region IV

Prepared by

Florida Department of Environmental Protection
Hazardous Waste Compliance Assistance Program

Satish Kastury, Administrator
Janet Ashwood, Project Manager
Mike Redig, Tallahassee
Glen Perrigan, Tallahassee
John Scarboro, Tallahassee
Vicky Valade, Northeast District
Richard Sykes, Northeast District
John White, Central District
Beth Knauss, Southwest District
Jeff Smith, Southeast District
Laura Comer, South District
Charles Emery, South District

and
Florida Center for Solid and
Hazardous Waste Management

John Schert, Executive Director
Anita Kugler, Technical Editor
Joni Schmidt, Graphic Artist
Joy Glanzer, Graphic Editor

With assistance from

Photo Marketing Association International
Steve Noble, Manager, Environmental Activities

This document was printed at a cost of $.314 per copy on recycled paper with soy-based inks. November 1997.

WHY SHOULD I CARE ABOUT HAZARDOUS WASTES?

As a business owner, operator, or employee, you may be producing materials that can harm people and the environment.
This booklet offers helpful tips on how to:

- Comply with federal and state hazardous waste regulations.
- Avoid penalties by properly managing hazardous wastes.
- Save money on disposal costs by reducing hazardous wastes.

Health and Environment

Hazardous wastes spilled or dumped on the ground or disposed of in dumpsters may seep into the ground water and contaminate drinking water supplies.

Hazardous wastes may run off into the nearest body of water where they may poison of kill fish and other wildlife.

Hazardous wastes pose a health risk to you, your employees, and your community.

Cost Savings

State and county inspectors may visit your business to ensure that hazardous wastes are being managed properly. State penalties may range from $100 to $50,000 **Per Violation Per Day.**

Reducing hazardous wastes can reduce your production and disposal costs and reduce your risk of future liability.

Public Image

Your customers will appreciate your efforts to prevent pollution.

Your community will recognize your business as a good neighbor.

WHAT IS A HAZARDOUS WASTE?

A waste is hazardous if:

- It has any of the characteristics described below.
- It is listed as a hazardous waste in the Code of Federal Regulations, 40 CFR Part 261.

Characteristic Wastes

Ignitable

Ignitable Wastes are easily combustible or flammable. If they have a flashpoint of 140$_{o}$ F or less or an alcohol content of 24% or more, they are hazardous wastes.

Corrosive

Corrosive wastes corrode metals or other materials or burn the skin. These liquids have a pH of 2 or lower or 12.5 or higher.

Reactive

Reactive wastes are unstable and react rapidly or violently with water or other materials.

Toxic

Wastes are toxic if they contain heavy metals, such as chromium, lead or cadmium, or toxic chemicals.

Listed Wastes

A waste is hazardous if it is listed in the Code of Federal Regulations, 40 CFR Part 261. For details on listed wastes and waste code numbers, contact the Florida Department of Environmental Protection. (See end of manual for DEP phone numbers) The Code of Federal Regulations is available at most libraries or may be purchased from the U.S. Government Bookstore (phone: 904-353-0569).

Acutely Hazardous Wastes

Small amounts of very dangerous wastes, such as arsenic and cyanide compounds, are regulated in the same way as large amounts of other wastes. A business that generates 2.2 pounds (1 kilogram) or more of these acutely toxic wastes per month is subject to full regulation under the hazardous waste rules.

Identifying Your Hazardous Wastes

It is very important to determine whether a waste is hazardous or non-hazardous. There are several ways to identify hazardous wastes.

- Obtain and read Material Safety Data Sheets(MSDS)
- Talk to product suppliers and manufacturers.
- Read product labels.
- Compare product and process information to hazardous waste characteristics and to wastes listed in federal regulations.
- If product or process information is not available or is inconclusive, have a commercial lab sample and test the waste using the TCLP test.
- A non-hazardous material or product may become a hazardous waste due to contaminants added during use. Lab testing may be necessary.

Sources Of Hazardous Waste

Waste Source	Waste Stream Description	Waste Stream Composition
Cleaning/Surface Preparation	Airborne particulates Acid fumes/organic vapors Spent acid/alkaline solution Spent halogenated solvents Waste rinse water.	Board materials, sanding materials, metals, fluoride, acids, halogenated solvents, alkali
Catalyst Application/ Electroless Plating	Spent electroless copper bath Spent catalyst solution Spent acid solution Waste rinse water	Acids, stannic oxide, palladium, complexed metals, chelating agents
Pattern Printing/Masking	Spent developing solution Spent resist removal solution Spent acid solution Waste rinse water	Vinyl polymers, chlorinated hydrocarbons, organic solvents, alkali
Electroplating	Spent plating bath Waste rinse water	Copper, nickel, tin, tin/lead, gold, fluoride, cyanide, sulfate
Etching	Spent etchant Waste rinse water	Ammonia, chromium, copper, iron, acids

How Should I Manage Hazardous Wastes?

First, determine how much hazardous waste you generate each month. The rules you must follow depend on how much you generate, how much you store, and how long you store it.

- **Less than 220 pounds** (100 kilograms or about half a drum): you are a "Conditionally Exempt Small Quantity Generator."
- **220-2,200 pounds** (100-1,000 kilograms, or about half a drum to 5 drums): You are a "Small Quantity Generator."
- **More than 2,200 pounds** (1,000 kilograms or more than about 5 drums): you are a "Large Quantity Generator."

The following practices may be required for your business. Even if they are not required, they are good waste management practices. Additional information is available from DEP.

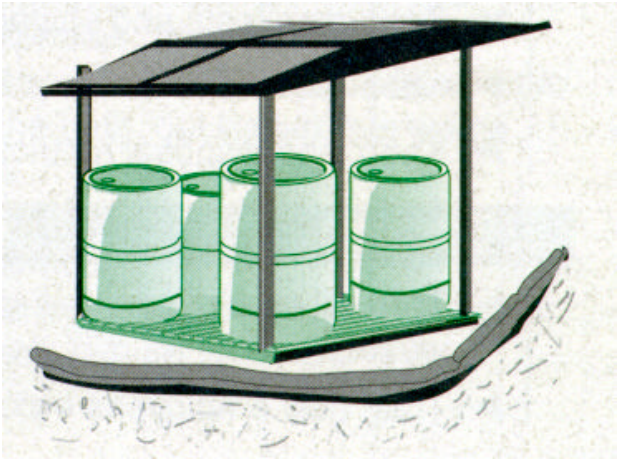
Containers

- Maintain containers in good condition. Prevent leaks, ruptures, and accumulation of rainwater on tops of drums.
- If a container leaks, transfer waste to a new container.

- Keep containers closed. Use self-closing funnels.
- Wastes must be compatible with the container. For example, use HDPE plastic containers for corrosive wastes.
- Never place incompatible wastes, such as wastes that react with each other (acids and bases), in the same container.

Storage

- Maintain adequate aisle space between container rows to allow inspection for leaks and damage.
- Store ignitable and reactive wastes at least 50 feet from property boundaries.
- Store containers of incompatible wastes in separate areas.
- Be aware of allowable time limits for storage.



Labels

- Label every container with the type of waste and whether it is hazardous or non-hazardous.
- Include federal waste code numbers.
- Include the accumulation start date (the date when waste was first placed in the drum).
- Include your businesses name and address.
- Use the following words on labels for hazardous wastes:

HAZARDOUS WASTE
FEDERAL LAW PROHIBITS IMPROPER DISPOSAL

If found, please contact the nearest police or public safety authority or the U.S. EPA

(Your business's name and address and manifest document number)

Transport and Disposal

- Make sure your transporter and disposal facilities have EPA identification numbers.
- Use manifests for all hazardous wastes shipped offsite.

Inspection and Record Keeping

- Inspect all containers at least once a week and keep a written log of container inspections.
- Keep training and inspection records for 3 years.
- Keep manifests and shipping receipts for 3 years.
- Keep records of lab tests for 3 years.
- Keep land disposal restriction forms for 3 years.

Training

- Train all employees to identify, reduce, and properly handle wastes.
- Train new employees before they handle hazardous wastes.

How Can I Reduce Hazardous Wastes?

Reducing hazardous wastes in your shop makes good business sense. Benefits include:

- Saving Money on waste management costs
- Reducing concerns about penalties and liability.
- Creating a safer, healthier workplace.
- Promoting positive public relations with clients, customers, and the local community.

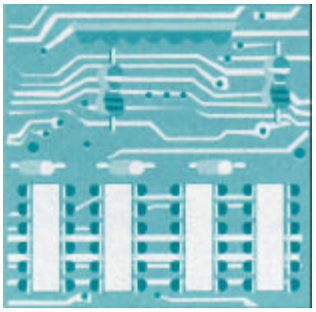
How Do I Begin?

- Make a commitment to reducing wastes in every area of your business.
- Evaluate your shop's wastes and identify areas where changes can be made.
- Encourage the participation of all employees through education, training, and incentives.

Cleaning and Surface Preparation

- Use abrasive instead of aqueous cleaners. -
  Before Electronic components have been added to the boards, abrasives such as plastics, ceramic, or aluminum oxide can be used to remove oxidation layers, old plating, paints and burrs, and to create a smooth surface. To prevent damage to the part, select a blast medium that is harder than the layer to be stripped but softer than the substrate.

- Use non-chelated cleaning chemicals and mild chelators. -
  Chelators in chemical process baths allow metal ions to remain in solution beyond normal solubility limits, creating hazardous waste sludge. Common chelators include ferrocyanide, EDTA, phosphates, and ammonia. Non-chelated process baths may require continuous filtration to remove solids formed in the bath, but hazardous waste generation is reduced.
- Reuse or recycle cleaning agents. -
  Ion exchange systems can be used to recover metals and salts so that cleaning agents can be reused.
- Reuse or recycle rinse water. -
  Closed circuit rinsing systems can dramatically reduce the hazardous chemicals content of rinse water. Effluent from a final rinse can be used for rinse operations that do not require high rinse efficiencies. For some processes, effluent from a rinse system that follows an acid cleaning bath can be reused as influent water to a rinse system following an alkaline cleaning bath.
- Use countercurrent or cascade cleaning systems. -
  When electroplating racks are cleaned in a nitric acid bath, the nitric must be disposed of when the copper content gets too high to clean effectively. A cascade cleaning system can significantly reduce nitric acid waste generation
- Substitute for CFCs used in defluxing. -
  1. Use a fully aqueous system with water-soluble fluxes.
  2. Use an aqueous system using saponifiers to remove rosin-based fluxes.
  3. Use a semi-aqueous system with terpenes as a solvent.
  4. Use hydrogenated CFC's with chlorinates solvents. Substitute CFC-113 used in hand cleaning boards with a blend of HCFC and methanol.
- Install a system, such as a Low Solids Fluxer (LSF), which applies flux to printed wiring boards, leaving little residue, and eliminating the need for cleaning with CFCs.



Pattern Printing and Masking

- Use aqueous processable resist instead of solvent processable resist.
  Aqueous processable resists have become increasingly popular because they eliminate the generation of toxic spent solvents.
- Use Screen-printing instead of photolithography to eliminate the need for developers.
  Recent advancements in screen-printing techniques have resulted in higher degrees of resolution with screen printing than in the past.

- Use Asher dry photoresist removal method to eliminate the use of organic resist stripping solution.
  This method is widely used in the semiconductor industry, but may not be applicable for printed circuit boards where resists are thicker than the corresponding semiconductor resist layers.
- Recycle or reuse photoresist stripper.
  Photoresist stripper collects in small flakes in the stripper tank. When flakes begin to adhere to circuit boards, the stripper solution is considered spent but its chemical strength is not necessarily reduced. Stripper solution can be reused if it is decanted and filtered into a clean tank.

Electroplating and Electroless Process

- Use mechanical board production methods/systems.
  Circuit boards can be designed on a computer and the pattern is etched with a mechanical stylus on a copper-clad board. This method is best suited for research and development facilities and other low-volume operations.
- Use non-cyanide-plating baths and non-cyanide stress relievers. -
  By substituting polysiloxanes for stress-relief cyanides, the hazardous nature of the spent bath solutions can be reduced.
- Extend process bath life by reducing impurities.
  - Proper rack design and cleaning can minimize contamination from corrosion and salt deposits.
  - Fluorocarbon rack coatings also help reduce impurities.
  - Using purer metals for anodes reduces impurities from anode metals dissolving in the plating solution.
  - Efficient rinsing between process baths reduces drag-in of plating solution into the next process bath.
  - Use de-ionized or distilled water to prevent impurity buildup from minerals or solids in tap water.
  - Avoid prolonged storage of mixed solutions to reduce potential for chemical reactions that could generate contaminants that reduce bath life.
- Extend process bath life by reducing the loss of solution from the bath (drag-out).
  - Minimizing the chemical concentration of the process bath reduces drag-out losses. Determine the lowest concentration needed.
  - Lower concentrations of some chemicals may reduce the viscosity, improving drainage. Increasing the bath operating temperature lowers both the viscosity and surface tension of the solution. Note that energy costs may be increased and the need for air pollution control may increase due to the higher evaporation rate.
  - Determine whether wetting agents can be added to process baths. Wetting agents can create foaming problems, but they reduce drag-out by as much as 50%.
  - Recover drag-out losses by using drain boards, closed circuit rinsing, and drag-out tanks.
  - Proper positioning of workpieces on plating racks maximizes draining of excess solution back into the bath. Rack pieces as vertically as possible, with longer dimension horizontal. The lower edge should be tilted from the horizontal so that runoff is from the corner and not an entire edge. Circuit boards should not be allowed to drip onto an adjacent board.
  - Train line operators to withdraw boards slowly from the process bath, allowing ample drainage. Ensure that drainage time on the rack is adequate and not rushed.

- Maintain bath solution quality.
  - Monitor solution actively frequently and replenish reagents or stabilizers as needed.
  - Control bath temperature and monitor heating and cooling coil efficiency.
  - Use mechanical agitation instead of air agitation to prevent contamination from carbon dioxide and oil from the compressor or blower.
  - Use continuous filtering/carbon treatment to remove impurities.

- Improve rinse efficiency between bath operations.
  - Maintain turbulence and sufficient contact time between the workpiece and the rinse water.
  - Maintain sufficient volume of water during contact time to reduce the concentration of chemicals rinsed off the workpiece surface.
  - Use sprays or fog rinsing as a first step before immersing workpieces in a dip rinse tank.

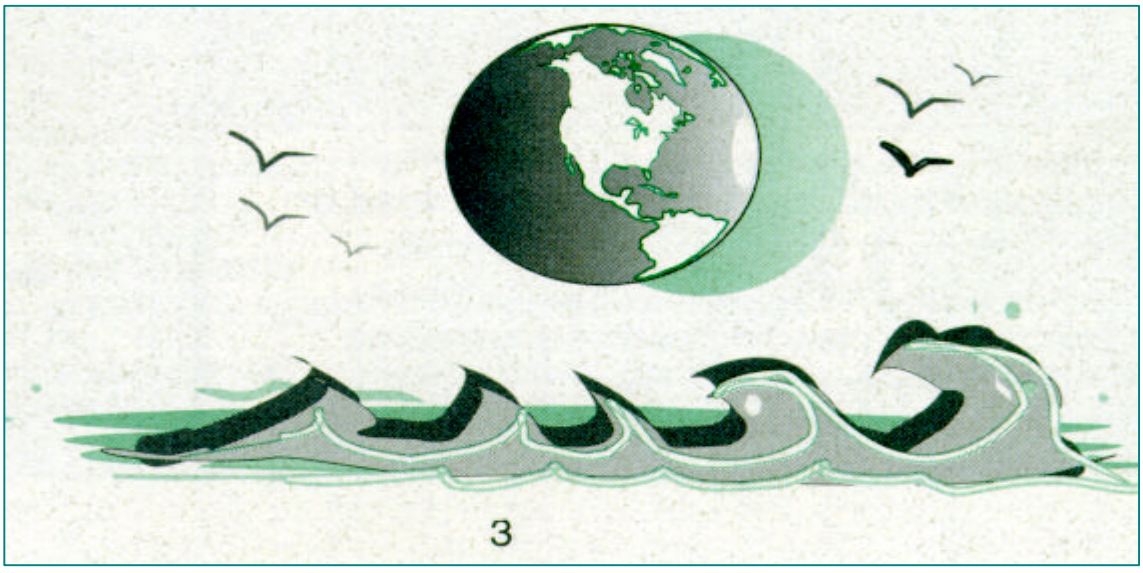
- Recovery and reuse of spent materials.
  - Segregate rinse streams to facilitate recycling, reuse, and metal reclamation.
  - Save money on pretreatment by recovering copper and other metals and metal salts.
  - Choose the best equipment and system.
    - Evaporative methods are 90-99% effective in recovering materials.
    - Reverse osmosis is commonly used to recover nickel plating solutions and regenerate rinse waters.
    - Liquid membranes can be used to remove chromium from rinse waters spent etching baths.
    - Ion exchange units effectively concentrate metals from dilute rinse streams onto a resin metal.
    - Electrolytic systems are most efficient on concentrated solutions.
    - They can recover 90-95% of available metals and are commonly used to recover gold, silver, tin, copper, zinc, solder alloy, and cadmium.
    - High surface area electrowinning/electrorefining is a chemical technology that can effectively recover a wide variety of metals and regenerate many types of solutions.

Wastewater Treatment

- Segregate waste streams, such as chelating agent and non-chelating agent waste streams. Segregating cyanide-containing waste streams from those containing iron or complexing agents prevents the formation of cyanide complexes, making treatment easier.
- Segregation of waste streams containing different metals makes metal recovery and reuse easier.
- Consider using alternative treatment chemicals to reduce the volume of sludge generated.
- Ion exchange systems with activated carbon treatment systems can be used to recycle rinse water.

Etching

- Determine whether differential plating can be used in your facility instead of the conventional electroless plating process. Differential plating substantially reduces the amount of copper that must be subsequently etched away in the subtractive method.
- Use non-chelated etchants such as sodium persulfate and hydrogen peroxide/sulfuric acid as substitutes for ammonium persulfate chelate etchant.
- Use thinner copper foil to clad the laminated board. This reduces the amount of copper which must be etched, reducing the amount of waste generated from the etching process.
- When possible, use pattern instead of panel plating. Pattern plating requires copper electroplating only the holes and circuitry, and not the entire board area as in panel plating.
- Consider using the additive instead of the subtractive method, which eliminates the copper etching step. This method substantially reduces volumes of spent etchant as well as the amount of metal hydroxide sludge's generated.
- Use non-chrome etchants, such as ferric chloride or ammonium persulfate solution, instead of chromium-sulfuric acid etchings, to reduce the toxicity of the wastes generated.
- Recycle spent etchants using an electrolytic diaphragm cell.



WHO NEEDS TO KNOW IF MY BUSINESS GENERATES HAZARDOUS WASTES?

Notify DEP

- If your business is a small or large quantity generator, notify DEP to obtain an EPA identification number. Local environmental agencies should also be notified.

Notify Local Authorities

- Police and fire departments and local hospitals that would respond to an emergency need to know that there are hazardous wastes on your property.

Designate an Emergency Coordinator

- This person must know what to do in case of a fire, spill, or other emergency and must be on the premises or on call 24 hours a day.

Develop a Contingency Plan

Guidance on contingency plans is available from DEP. Large quantity generators must have a written plan that includes:

- Emergency response arrangements with police, fire, hospitals, and emergency response contractors.
- Emergency coordinators' addresses and phone numbers.
- On-site emergency equipment descriptions and locations.
- Evacuation plan and routes, including a site diagram.
- Spill reporting procedures.

Post Emergency Information

Post the following information near every telephone:

Fire Department Phone Number
Emergency coordinator's name and phone number
Locations of fire alarms and extinguishers
Locations of spill control materials

CHECKLIST 

This checklist will help you to prevent the most common hazardous waste violations.
For more detailed information on hazardous waste management requirements, contact DEP.

- ☐ Identify types and quantities of hazardous wastes.
- ☐ Notify Florida DEP and obtain an EPA identification number from DEP
- ☐ Use proper containers to collect and store wastes.
- ☐ Label all containers as hazardous or non-hazardous wastes.
- ☐ Include accumulation start dates on labels.
- ☐ Keep containers of hazardous waste closed.
- ☐ Maintain aisle space between containers for inspection.
- ☐ Inspect containers weekly for rust, leaks, or damage and keep inspection records for at least 3 years.
- ☐ Never discharge hazardous wastes to a septic tank unless you have a DEP permit.
- ☐ Train employees to properly handle hazardous waste.
- ☐ Designate an emergency coordinator.
- ☐ Notify police, hospitals, and fire department.
- ☐ Post emergency information near each phone.
- ☐ Develop a contingency plan for emergencies.
- ☐ Use manifests for all waste transported for disposal.
- ☐ Keep all records for at least 3 years.

WHERE CAN I GET MORE INFORMATION?

Additional information on hazardous waste reduction and regulations is available from many sources.

Florida Department of Environmental Protection

District offices and the Tallahassee office offer technical assistance, fact sheets, and other publications on hazardous waste regulations.

- Hazardous Waste Compliance Assistance Program

  Phone: (850) 488-0300
  Fax: (850) 921-8018

Available publications include: Summary of Hazardous Waste Regulations
Requirements for Conditionally Exempt Small Quantity Generators
Requirements for Small Quantity Generators
Handbook for Small Quantity Generators of Hazardous Waste

Florida Small Business Assistance Program

The Small Business Assistance Program helps businesses with environmental concerns and problems related to compliance with air regulations. Assistance is confidential and staff experts have business experience.

- Phone: (800) 722-7457

U.S. Environmental Protection Agency

The EPA has published a series of industry-specific guidelines and handbooks on preventing pollution and complying with hazardous waste regulations.

- RCRA Hotline (800) 424-9346

Your Trade Associations

Many trade associations have published guides to help you find solutions to your hazardous waste management problems.

OFFICES OF THE FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Northwest District
160 Government Center
Pensacola, FL 32501-5794
850/444-8300 (SC 695-8300)

N.W. Dist. Branch Office
2353 Jenks Ave.
Panama City, FL 32405
850/872-4375 (SC 777-4375)

N.W. Dist. Branch Office
2815 Remington Green Cir
Suite A
Tallahassee, FL 32308-1513
850/488-3704 (SC 278-3704)

Northeast District
7825 Baymeadows Way
Suite B200
Jacksonville, FL 32256-7590
904/448-4300 (SC 880-4300)

N.E. Dist. Branch Office
101 N.W. 75th St.
Suite 3
Gainesville, FL 32607-1609
352/333-2850 (SC 627-2850)

Central District
3319 Maguire Blvd.
Suite 232
Orlando, FL 32803-3767
407/894-7555
(SC 325-2290)

Central Dist. Branch Office
13 East Melbourne Ave.
Melbourne, FL 32901
407/984-4800
(SC 350-4800)

Southwest District
3804 Coconut Palm Dr.
Tampa, FL 33619-8318
813/744-6100 (SC 512-1042)

S.W. Dist. Satellite Office
170 Century Blvd.
Bartow, FL 33830-7700
941/534-1448 (SC 572-6200)

S.W. Dist. Satellite Office
6700 Clark Rd.
Sarasota, FL 34241
941/361-6178

South District
2295 Victoria Ave
Suite 364
P.O. Box 2549
Ft. Myers, FL 33091
941/332-6975 (SC 765-5815)

South Dist. Branch Office
7451 Golf Course Blvd.
Punta Gorda, FL 33982
941/575-5814 (SC 765-5815)

South Dist. Branch Office
2796 Overseas Highway
Suite 221
Marathon, FL 33050
305/289-2310 (SC 464-2310)

Southeast District
400 N. Congress Ave.
P.O. Box 15425
West Palm Beach, FL 33416
561/681-6600
(SC 226-6600)

S.E. Dist. Branch Office
1801 S.E. Hillmoor Dr.
Suite C-204
Port St. Lucie, FL 34952
561/871-7662
(SC 222-7662)

David B. Struhs, Secretary
Florida Department of Environmental Protection

Division of Waste Management
Twin Towers Office Building 2600 Blair Stone Road
Tallahassee, Florida 32399-2400
850-487-3299 ***www.dep.state.fl.us***